COUNTDOWN ACID RAIN

GOVERNMENT REVIEW OF THE TWELFTH PROGRESS REPORTS (JANUARY 31, 1992) BY ONTARIO'S FOUR MAJOR SOURCES OF SULPHUR DIOXIDE

Ontario Ministry of the Environment

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EXECUTIVE SUMMARY

This is the review of the four Countdown companies' 12th semi-annual progress reports, required under Ontario's acid rain regulations. Each of the four sources has met the legal limits for sulphur dioxide and acid gases (SO_2 plus NO_x) to date and are implementing their planned abatement programs to meet 1994 SO_2 emissions targets.

INCO LIMITED

Inco's 1991 SO_2 emissions were 572 kt. SO_2 Abatement Project costs have risen from $494 million to $600 million due to labour disruptions in 1990 and some scope changes. With completion of the mills rationalization program and process changes already in place, Inco expects 1992 SO_2 emissions to be 100 kt less than its current limit of 685 kt. When the overall SO_2 project is fully implemented Inco's sulphur containment would increase from 70 % to 90 % in the ore mined and processed. Commissioning of the new flash furnace and the double contact acid plant was achieved successfully in 1991.

FALCONBRIDGE LIMITED

In 1991, the company's SO_2 emissions were 69.6 kt of SO_2 and the smelter operated at 84 % capacity. The company reaffirms its current operational capability to meet the 1994 annual SO_2 emissions target of 100 kt at the smelter design capacity of 88 million pounds of nickel. The company's continued investment in the smelter, coupled with the research program, will enable Falconbridge to meet its voluntary SO_2 emission target of 75 kt before 1998. The R & D effort is aimed at increased pyrrhotite rejection and higher sulphur elimination through roasting.

ALGOMA STEEL CORPORATION

Algoma's SO_2 emissions from its sinter plant at Wawa were 53.4 kt in 1991 at a sinter production level of 1.133 million tonnes. Algoma will meet the 1994 SO_2 emissions limit of 125 kt by lowering the sulphur content in feed materials and production cutbacks. Algoma's current plans are to continue sinter production until 1996 at about this level.

ONTARIO HYDRO

Ontario Hydro's SO_2 and acid gas emissions were 167 kt and 223 kt in 1991. Both SO_2 and acid gas emissions were lower than Hydro's 1990 emissions and were also below the 1991 regulation limit of 1991 by 30% and 21% respectively. In 1991, Hydro spent $305 million on measures contributing to acid gas control. Hydro's Lambton flue gas scrubbing project is on schedule for 1994 completion. Hydro also plans to limit NO_x emissions to 58 kt (NO2) from 2000 onwards and efforts are being made to reduce this even further.

INTRODUCTION

Four major corporate sources (Inco, Falconbridge, Algoma at Wawa, and Ontario Hydro) produce over 80% of Ontario's sulphur dioxide (SO_2) emissions. Each source is required by Ontario's Countdown Acid Rain regulations to report every six months on the progress made to reduce SO_2 emissions.

The Countdown program was formulated in 1985 and placed an annual SO_2 emissions cap of 885 kt (new proposed limit 877 kt) on all sources in the province, to be in place by 1994. Specific reductions in SO_2 for the four companies began in 1986 and culminate in a cap totalling 665 kt by 1994. In the case of Ontario Hydro, limits were also placed on the combined emissions of SO_2 and nitric oxide (NO) and an interim cut of 35% limiting SO_2 to 240 kt and acid gases (SO_2 + NO) to 280 kt was also imposed for 1990-1993. The Countdown limits are in addition to standards imposed to ensure good ambient air quality. Annual legal limits are summarized in Table 1.

Table 1
Sulphur Dioxide Legal Limits
(thousands of tonnes per year)

	1985	1986	1990	1994
Inco nickel/copper smelter, Sudbury	728	685	685	265
Falconbridge nickel/copper smelter, Sudbury	154	154	154	100
Algoma iron ore sintering plant, Wawa	285	180	180	125
Ontario Hydro fossil fuel power plants, province-wide	390	370	240	175
Legal Limits Sub-total :	1,557	1,389	1,259	665

Each of the four sources has met the legal limits to date and each has submitted detailed plans for implementing its reduction program, as required by the regulations. The sixth set of company progress reports, received in December 1988 and January 1989, set out the detailed methods and schedules for meeting the emission limits of the Countdown regulations. They were accepted by the government.

Implementation progress reports are required every six months. This document summarizes the contents of the 12th set of semi-annual company reports and the government response. Previous semi-annual reports are available from the Public Information Centre, Ontario Ministry of the Environment, 135 St. Clair Avenue West, Toronto, Ontario, M4V 1P5, (416) 323-4321.

COMPANY REPORTS AND GOVERNMENT RESPONSES

The progress reports were reviewed by a technical work group drawn from the Ontario Ministries of Environment, Northern Development and Mines (for the metallurgical companies) and Energy (for Ontario Hydro).

The implementation phase of the Countdown program is now well under way, and each of the four regulated companies reports its progress and current status in relation to the 1994 emission limits. A summary of the individual reports and the Ontario government's response follows.

INCO LIMITED

Regulation 660/85 requires a reduction in SO_2 emissions from Inco's nickel/copper smelter complex in Sudbury to no more than 265 kt for any year after 1993, compared to the current limit of 685 kt per year. The company was also required to examine the feasibility of going beyond the current limit of 265 kt by 1994 to a level of 175 kt at some future date. Consequently, the feasibility of continuing technical advances remains a concern of Inco and of the government. The government previously accepted Inco's position that a specific interim reduction was not feasible because of the nature of the major process changes being undertaken in order to meet the 1994 emission limit.

Company Report

The company's 12th progress report indicates that:

- Implementation of the Sulphur Dioxide Abatement Project is continuing as detailed in the report of December 1988 to meet the annual SO_2 emissions target of 265 kt after 1993. Sulphur dioxide abatement project costs have increased from $494 million (Inco's earlier estimate) to about $600 million due to the accelerated schedule needed as a result of labour disruptions in the summer of 1990 and some project scope changes. In spite of increased capital costs, the report indicates that the project will result in net annual savings of $90 million from this new technology when it is fully implemented and operating satisfactorily in 1994.

- The mills rationalization program was completed by mid 1991, the Frood Stobie mill was shut down on May 25, 1991 and all of the Ontario Division ore is now processed through the Clarabelle mill. Some difficulties are being experienced with the Semi Autogenous (SAG) mill which is still to be

optimized. The total capital cost of the mills rationalization program was $72 million.

- The construction schedule shows that all planned work detailed in the company's 6th semi-annual report (December, 1988) will be completed by December of 1993. The report also indicates that more than 75% of the Smelter Program Construction is now complete.

- Financial commitments as of October 31, 1991 of about $530 million have been made. This is approximately 88% of the total estimated revised project cost.

- Expenditures to-date total some $478 million, about 80% of the revised project costs of $600 million.

- The overall engineering has progressed to 94% of completion. The project engineering is on schedule and will be 100% complete by December 1992.

- As of October 1991, some 106 engineering and construction management personnel were working on the project. In addition to this, more than 265 trades personnel were involved in on-site contract work.

- The first of the two new oxygen flash furnaces, together with major ancillary facilities, was commissioned in October 1991. The new flash furnace has operated at the design rate and yielded satisfactory matte grades. Off-gases from this furnace after cleaning, were treated in the new 2,900 tonne per day (tpd) acid plant to convert SO_2 to sulphuric acid. The by-product sulphuric acid is marketed by Inco through Marsulex company.

- With the process changes currently being implemented in the nickel and copper smelting circuits, Inco's SO_2 emissions from these operations will be lowered by at least 100,000 tonnes per year in 1992 from the current maximum limit of 685,000 tonnes per year.

- When the overall SO_2 project is fully implemented in 1994, Inco's sulphur containment is expected to increase from the current level of 70% to 90% of the sulphur in the ore mined and processed.

- Inco's 1991 SO_2 emissions were 572 kt.

Government Review

The government review concluded that Inco continues to meet the requirements of Regulation 660/85. Representatives from Inco Ltd., and the Ministry's Approvals Branch and Regional/District

staff met in early February, 1992 to review and discuss draft Certificates of Approval for Inco's SO_2 Abatement Program. Several members of the Countdown Technical Support Group(CTSG) toured the smelter and mill complexes in late April 1992 and met with company representatives to review the progress of the program.

The main areas of discussion at this meeting are summarized below:

- The Ministry would like Inco Ltd. to provide additional information on each element of the project, simplified process flowsheets and a sulphur mass balance summary table in future semi-annual reports.

- During the plant tour Inco representatives provided answers to many CTSG questions arising out of Inco's previous semi-annual progress reports.

Mills Rationalization

- The Ministry wishes to be appraised of Inco's progress in resolving the difficulties experienced with the SAG mill.

Smelter

- The Ministry would like Inco Ltd. to report on developments in commissioning and optimization of Phase I of the project, namely the new oxygen flash furnace, oxygen plant and acid plant.

SO_2 Emissions And Ambient Air Concentrations

- The Company recently submitted to the Ministry an SO_2 emissions dispersion modelling study aimed at determining the impact of the SO_2 Abatement Program on ambient air quality in and around the Sudbury area.

Acid Plant

- The Ministry is pleased to note that Inco's new double contact acid plant is working well and has SO_2 concentrations below 500 ppm in the tail gases; in addition, the plume is transparent (i.e., no significant SO_3 in tail gases).

- The Company's efforts in attempting to find a reliable SO_3 analyser for continuous monitoring of SO_3 concentrations in the tail gas stack have not been successful. Inco Ltd.

proposes to continue with the periodic monitoring of SO_3 levels (grab sampling and pine stick method) and to use a video camera to detect abnormal levels of opacity, and hence SO_3 content, in the plume from the tail gas stack.

FALCONBRIDGE LIMITED

Regulation 661/85 requires Falconbridge to reduce SO_2 emissions from its Sudbury nickel-copper smelter complex to no more than 100 kt for every year after 1993. The regulation also requires Falconbridge to evaluate the possibility of reducing SO_2 emissions below the 100 kt per year level. Promising areas for further reductions have been identified by the company.

Company Report

The 12th progress report, covering the period July to December 1991, notes that:

- The company reaffirms its current operational capability in the smelter to meet the 1994 annual SO_2 emission limit of 100 kt at full smelter production capacity. This emission reduction achievement, at the design capacity of 88 million pounds of nickel per year, was the result of technical and operational developments by the company such as improved pyrrhotite rejection, increased degree of roasting and sulphuric acid production, enhanced slag cleaning operation, separate copper concentrate production, and increased smelting of recycled materials supplemented by custom feed.

- Falconbridge will continue to invest capital in the Strathcona Mill and smelter. The company anticipates that this investment, coupled with the research program will enable it to meet its voluntary SO_2 emission target of 75 kt before 1998.

- In 1991 the company emitted 69.6 kt of sulphur dioxide. This is approximately 25% of the sulphur entering the smelter.

- In 1991, the Falconbridge smelter operated at 86% (for the first half) and at 84% (for the second half) of the design capacity.

- The report also indicates that the capital budget for the process modifications over 1989-1993 is estimated at $38.5 million.

- During 1991, capital projects in the smelter area amounting to $2.9 million were completed and planned changes to the roasters, acid plant, electric furnaces, and converter areas are estimated to cost $2.5 million in 1992.

- Some scope changes to the original plan were made and these cover the acid plant absorbing tower modifications, electric furnace off-gas ducting modifications, and the removal of the acid plant booster fan. All planned smelter modification projects are expected to be in service before the end of 1993 per the current schedule.

- The report states that modernization of the Strathcona Mill has continued with the installation of the second phase of the large flotation cell program. Phase II of the large cell program is 95% complete and start-up is expected in early 1992. Several of the projects associated with the Strathcona Mill, amounting to about $14 million will be completed by the end of 1993.

- The mineral processing research and development program is focusing on alternative reagents and flowsheets to further improve pyrrhotite rejection. These schemes have reached pilot plant scale and tests will be conducted for at least another six months.

Government Review

The Countdown Technical Support Group (CTSG) concluded that the company's 12th semi-annual progress report met the requirements of Ontario Regulation 661/85 and that the implementation of the SO_2 abatement program is progressing on schedule. The CTSG is pleased with the technical progress Falconbridge has achieved in meeting its SO_2 emissions limit of 100 kt at full smelter production capacity three years ahead of schedule. The CTSG is further encouraged to note that the company's further investments in R & D and capital projects will likely enable Falconbridge to achieve its goal of SO_2 emissions level of 75 kt/yr earlier than 1998.

Additional comments are as follows:

- The CTSG is pleased with the company's reporting format and the level of detail provided in its semi-annual progress report.

- The CTSG members noted that the company's capital budget has increased by 20% over an earlier estimate of $32 million.

- The Government's concerns raised in the Tenth Semi-Annual Progress Report(Jan.1991) have been addressed satisfactorily.

Several members of the Countdown Technical Support Group toured the Falconbridge Smelter and the Strathcona Mill complex in late April 1992 and met with company representatives to review the progress of the SO_2 Abatement Program.

The main areas of discussion at this meeting are summarized below:

Smelter:

- The results of leachate tests on the modified converter slag has shown acceptable levels of leachate metals. In addition concentrations of metals in the ground water in the area of the slag pile show no adverse impact from slag disposal practices.

- The smelter R & D efforts are focussed on adjusting and fine tuning the process parameters in the fluid-bed roasting, electric furnace smelting, sulphuric acid production, and converting operations as a result of increased sulphur elimination in the fluid-bed roasters.

Strathcona Mill:

- The thrust of the R & D efforts is aimed at increased pyrrhotite rejection through improved mineral processing methods such as additional magnetic pyrrhotite separation, finer grinding, improved size classification of particles and enhanced chemical separation of minerals using alternate reagents.

- A significant effort is being expended on optimizing process controls through automation for improved operator control and process efficiency.

- Company representatives indicated that the increased amount of pyrrhotite to be rejected to the tailings disposal area will not adversely affect the capability of the Moose Lake treatment system to provide an acceptable effluent quality.

- The process flowsheets and sulphur disposition information provided by the company in this report was very helpful and should be included in the company's future semi-annual progress reports.

ALGOMA STEEL CORPORATION

The Algoma Steel Corporation (ASC) operates an iron ore sinter plant at Wawa, about 270 km northwest of Sault Ste. Marie. Regulation 663/85 limits current SO_2 emissions from the operation to 180 kt per year, dropping to no more than 125 kt per year for every year after 1993.

In August 1986, the sinter production capacity at Wawa was down-sized by about 50 per cent. When combined with reduced sulphur level in the feed, this has resulted in substantially reduced SO_2 emissions.

Company Report

The company's 12th semi-annual progress report confirms that the company will meet the 1994 SO_2 emission limit by the reduction of sinter capacity. In addition, continued and increased use of low sulphur iron oxides at Wawa will further reduce the level of SO_2 discharged from the sinter plant.

The 12th semi-annual progress report also indicates that:

- In 1991 Algoma's SO_2 emissions were 53.4 kt at the sinter production level of 1.133 million tonnes.
- The company is forecasting 1992 SO_2 emissions of about 47.7 kt, at a sinter production capacity of 1.05 million tonnes.

Government Response

- The CTSG concluded that the company continues to meet the requirements of Regulation 663/85.
- ASC's recent plans indicate that sinter production at its Wawa facility will continue till 1996 at about current levels. Consequently, SO_2 emissions are expected to continue to be well below the regulation limit of 125 kt set for 1994.

ONTARIO HYDRO

Regulation 281/87 requires Ontario Hydro to meet interim 1990 emission limits and imposes a tighter limit for 1994 and beyond. Separate limits are set for SO_2 alone and for the sum of SO_2 plus NO (nitric oxide), as shown in Table 2.

Table 2
Ontario Hydro's Sulphur Dioxide and
Acid Gas Emissions Limits

Period	Regulated Limits	
	SO_2	SO_2 + NO
	(kilotonnes per year)	
1986 to 1989	370	430
1990 to 1993	240	280
1994 and future	175	215

Company Report

The corporation reports that in 1991 acid gas emissions were estimated at 167 kt of SO_2 and 223 kt for SO_2 plus NO, respectively. Both SO_2 and acid gases emissions were lower than Hydro's 1990 emissions and also below the 1991 regulation limit for SO_2 and acid gases by 30% and 21% respectively.

The corporation reports expenditures during 1991 of $304.9 million on measures contributing to the reduction of acid gas emissions, as follows:

- $89.6 million was spent for flue gas desulphurization for the Lambton Thermal Generating Station (TGS).
- $29.5 million was incurred for flue gas conditioning at the Lambton, Nanticoke, and Lakeview TGS. This measure allows Hydro to burn low sulphur coal at these locations until suitable control measures e.g., FGD scrubbers are installed.
- $2.3 million for combustion process modifications.
- $176.0 million for a low sulphur coal premium, which was partially for acid gas control. This is approximately 77% of the total expenditure reported by Hydro for acid gas control in this report.
- $15.8 million for compliance with the emissions verification and reporting order issued by the Ministry in June, 1990 (this issue was raised at a recent Ont.Hydro\Min.of the Env. progress meeting and Hydro is going to review appropriateness of allocating 100 percent of these costs to SO_2 Abatement Program).
- $1.7 million for research and development.

- The cost of installation of two flue gas desulphurization (FGD) scrubbers using a limestone slurry system at Lambton G.S. is estimated to be $537.5 million. There has been no change from Hydro's earlier estimate in the 11th Semi-Annual Progress Report. The FGD program is on schedule and the two Lambton scrubbers are expected to be in-service by early 1994.

- The 12th semi-annual progress report also indicates that the installation of the flue gas conditioning (FGC) equipment with sulphur trioxide (SO_3) and ammonia (NH_3) conditioning agents has been completed for all units at Lambton and Nanticoke and is working satisfactorily, except when fired with a blend of U.S./Western Canadian coal with 0.6% sulphur, a small (≈5%) derating results for Nanticoke boilers. This is presently being investigated by Hydro engineers.

- Improvements to precipitators at the Lakeview TGS have resulted in higher dust collection efficiency even with minimum use of SO_3 for gas conditioning. Units 1 and 2 will be retrofitted with FGC-SO_3 system during the rehabilitation period in 1992.

- Hydro plans to implement combustion process modifications (CPMs) for all units at Lambton TGS and a second generation of CPMs for Nanticoke TGS by 1998. This will result in additional 30% and 15% NO_x emission reductions at these locations.

- A recent update of Hydro's Demand Supply Plan (D/SP) (January, 1992) indicated that Hydro plans to extend the life of the Lambton and Nanticoke TGS instead of building new electricity generating facilities. However, these life extensions would also include new environmental controls such as FGD, SCRs and fabric filters for these stations to lower adverse environmental impacts from SO_2, NO_x and air toxics.

Government Response

Some points noted by the reviewers are listed below:

- The Countdown Technical Support Group (CTSG) concluded that Ontario Hydro continues to meet the requirements of Regulation 281/87.

- The CTSG also noted that in 1991 the premiums paid for lower sulphur coals by Hydro were 78% higher than 1990.

- The CTSG is pleased to see that Hydro plans to take appropriate steps to limit NO_x emissions from the fossil fuel power plants to 58 kt (as NO_2) from 2000 onwards and efforts are being made to reduce these even further.